February 24, 2011

To: Robin Schrock (TRRP ED), Ernie Clarke (TRRP SC), and Tim Hayden (TRRP Flow WG coordinator)

From: Joe Polos, TRRP Fish Work Group Coordinator

Subject: Projected Klamath River Fall Chinook Salmon Inriver Run Size for 2012

During the February 8, 2012, TRRP Fish Work Group meeting there was an update on the 2011 Klamath River fall Chinook salmon run (KRFC), particularly the large jack (age 2) return (Table 1). The numbers of age 2, age 3 and age 4 fish returning in one year are used to predict the population size in the ocean the following year. Additionally, during the discussion of water year 2012 planning, the efforts of the fall flow subgroup were discussed. The TRRP Flow WG has developed criteria for implementing fall flow measures and is currently updating this information.

The Fish Work Group wanted to alert the TMC and the TRRP Flow Work Group of the potential large KRFC inriver run in 2012, in addition to concerns with the dry conditions occurring in the Klamath Basin. In northern California, the current snow water equivalent is 35% of average for mid-February, just slightly greater than the lowest year on record (1976-1977; Figure 1). The KFRC inriver run (hatchery and natural fish combined) may be as large as approximately 350,000 adults in 2012 (Table 2). In addition to this, there will be a jack component (age 2 fish) to the inriver run in 2012 of which there is no preseason estimate. In 2002, the year of the fish kill, the adult KRFC inriver run was 161,000 fish (Figure 2) and the total inriver run (jacks and adults) was 170,000 fish..

This information pertaining to the estimated inriver KRFC run this fall is **very preliminary** and there may be large changes as data continue to be analyzed. Additionally, there is large variability in the accuracy of these projections, especially for the age 3 component, but it should be expected that there will be a large return in 2012. Any updated information developed as the Pacific Fishery Management Council (PFMC) proceeds with its fishery management planning in the coming months will be provided. These estimates were derived by applying seasonal mortality and harvest impact factors (Attachment A) which will not produce the same values that will be modeled in the PFMC stock assessment process.

Additionally, a cursory look at the relationship between Klamath Basin spring Chinook inriver run size and fall Chinook inriver run size was conducted (Attachment B). This analysis will be updated when the recent spring Chinook salmon “megatable” is available. While this is a strong relationship, there is greater variability at larger populations sizes and the fall Chinook inriver

run is beyond the range of the dataset used to develop the relationship. With these caveats in mind, the projected inriver size of adult spring Chinook salmon in 2012 is 84,500 fish.

The Fish Work Group will also provide other pertinent information that may be developed over the next several months.

Summary:

A large Klamath River fall Chinook salmon inriver run is expected in 2012, approximately 350,000 adults, and the dry hydrologic conditions occurring in the Klamath Basin raise concerns over the potential for a fish-kill. Additionally, there may also be a large spring Chinook salmon inriver run. The TRRP Flow WG has been developing documents to assist in implementing a fall flow effort, if needed, in addition to their efforts in in evaluating conditions pertaining to the need for a fall flow. While the data on Klamath fall Chinook salmon inriver run size are **very preliminary**, we feel that they are suitable to inform the TRRP that a very large inriver run in 2012 should be anticipated. Additionally, while there is still time in the water year for more precipitation, it is likely than below average hydrologic conditions will occur this water year and TRRP should plan accordingly.

Table 1. Klamath Basin fall Chinook salmon age specific estimates of the 2011 inriver return (estimates include both hatchery and natural fish). [1]

Age	2011 return
2	85,840
3	59,776
4	41,243
5	1,986
Total Adults	103,005

1. Age specific population estimates for the 2011 return from KRTT 2011 Klamath Basin Age Composition Report, Feb 2012.

Table 2. **Preliminary** Klamath Basin fall Chinook salmon age specific adult inriver run prediction for 2012 assuming full fishing in ocean fisheries (harvest rate = 0.16 on age 4 Klamath River fall Chinook salmon). No estimates are made for jacks (age 2 fish). See Attachment 1 for explanation of how estimates were derived.

Age	Inriver run (1000s)
3	302.7
4	47.0
5	2.5
Total	**352.2**

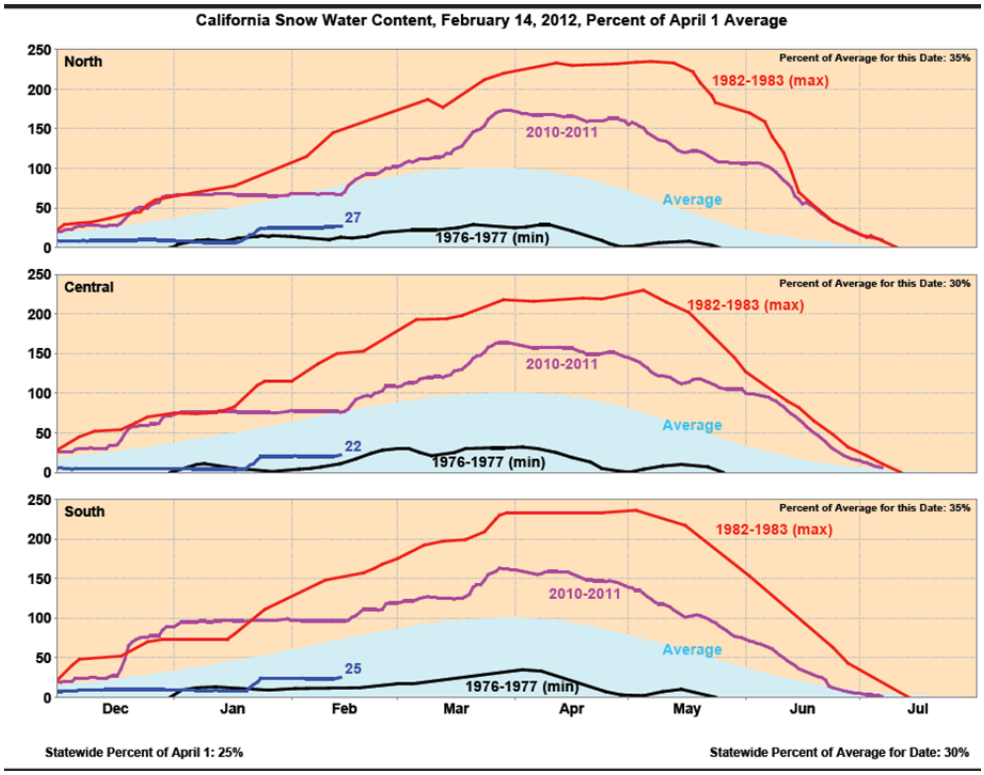

Figure 1. Current state wide California snow water content (blue line) along with extremes and average for the period of record.

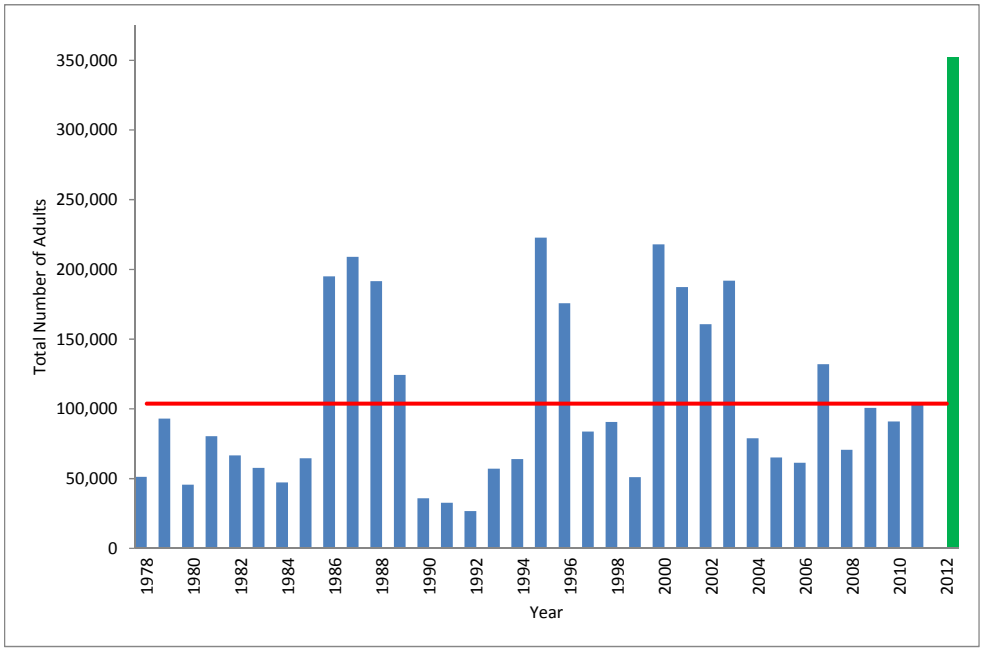

Figure 2. Klamath River adult fall Chinook salmon inriver run, 1978-2011, and projected 2012 inriver run. Horizontal red line is 1978-2011 mean.

Attachment A. Derivation of Klamath Basin fall Chinook salmon inriver run for 2012.

The 2012 adult Klamath River fall Chinook salmon (KRFC) inriver run was estimated using the sibling regression models (zero-intercept) to estimate the ocean population (Table A1, KRTT 2011). Overwinter survival, ocean impact parameters and age-specific maturity rates (PFMC and NMFS 2007) were used to estimate the 2012 inriver run (Table A2). The harvest rate of 0.16 for age 4 KRFC was used in this analysis which is the maximum allowed under the Endangered Species Act to protect Coastal California fall Chinook salmon populations. All population estimates are for hatchery and natural fish combined. The following equations were used to generate age-specific populations estimates:

1. Number of age (*i)* KRFC in the ocean in the fall (Sept 1) of year (*t-1)*=
   $N(O_{Sept1})_{i,t-1} = N(R)_{i-1,t-1} * B_i$., where B_i slope parameter of the zero intercept regression model for age(i-1) to age *i* fish between inriver return, $N(R)_{i-1,t}$, and siblings remaining in the ocean.

2. Number of age *i* KRFC in the ocean the following spring (May 1) of year *t* =
   $N(O_{May\ 1})_{i,t} = N(O_{Sept\ 1})_{i,t-1} * S_i$., where S_i is the age specific overwinter survival.

3. Number of age *i* KRFC contacted by ocean fisheries in year *t*:
   $N(C)_{i,t} = N(O_{May\ 1})_{i,t} * V_i * HR_{(t)}$, where V_i is the age specific vulnerability and $HR_{(t)}$ is the ocean harvest rate of age 4 KRFC in year *t*.

4. Number of age *i* KRFC landings in year *t* =
   $N(L)_{i,t} = N(C)_{i,t} * \%L_i$, where $\%L_i$ is the percentage of legal sized fish of age *i*.

5. Number of age *i* KRFC shaker mortalities of undersized fish in year *t* =
   $N(S)_{i,t} = N(C)_{i,t} * (1-\%L_i) * SM$, where SM is the shaker mortality rate.

6. Number of age *i* KRFC suffering mortality due to contact with fishing gear in year *t* =
   $N(D)_{i,t} = N(C)_{i,t} * DO$, where DO is the drop-off mortality rate.

7. Number of age *i* KRFC ocean fishery impacts in year *t* =
   $N(OI)_{i,t} = N(L)_{i,t} + N(S)_{i,t} + N(D)_{i,t}$.

8. Number of age *i* KRFC in the ocean on August 31 following ocean fishery impacts =
   $N(O_{Aug31})_{i,t} = N(O_{May\ 1})_{i,t} - N(OI)_{i,t}$

9. Number of age *i* KRFC fish returning to the river in the fall (Sept 1) of year *t* =
   $N(R_{Sept1})_{i,t} = N(O_{Aug31})_{i,t} * MR_i$,where MR_i is the age specific maturity rate.

References

KRTT. 2011. Ocean Abundance Projections and Prospective Harvest Levels for Klamath River Fall Chinook, 2011 Season

PFMC and NMFS. 2007. Final environmental assessment for Pacific Coast salmon plan amendment 15: An initiative to provide de minimis ocean fishing opportunity for Klamath River fall Chinook. Pacific Fishery Management Council, Portland, Oregon.

Table A1. Klamath River fall Chinook salmon age specific estimates of the 2011 inriver return and corresponding estimates of fish remaining in the ocean in the fall (August 31) of 2011 from each respective brood year.

Age	Regression Slope Parameter (zero intercept model) [1]	2011 inriver return (1000s) [2]	Ocean 2011 estimate (Sept 1) (1000s) [3]
$2_{inriver}$ to 3_{ocean}	18.2920	85.84	1570.2
$3_{inriver}$ to 4_{ocean}	1.3330	59.776	79.7
$4_{inriver}$ to 5_{ocean}	0.1120	41.243	4.6
$5_{inriver}$	N/A	1.986	N/A

1. Source of slope parameters: KRTT. 2011 and do not reflect any refinement that may occur through analyses that will occur in developing the 2012 stock projection.
2. Source: KRTT. 2012.
3. Ocean population estimated by multiplying the number of fish retuning to the river by the age specific regression slope parameter.

Table A2. Klamath fall Chinook salmon ocean and inriver population estimates for 2012. All calculation based on assumed age 4 harvest rate of 0.16 which is the maximum rate allowed in ocean fisheries due to ESA constraints for Coastal California fall Chinook salmon populations.

Max Ocean HR = 0.16															
Age	2011 Ocean estimate (Sept 1) (1000s)	Survival[1]	2012 Ocean Population in May (1000s) [2]	Vulnerability [1]	%legal [1]	Contacts (1000s)	Landings (1,000)	Shaker mortality [1]	Shaker impacts (1000s)	Drop-off Rate [1]	Drop-off impacts (1000s)	Ocean Impact (1000s)	Ocean popn after fishing impact (1000s)	Maturity Rate [3]	Inriver run (1000s)
3	1570.2	0.5	785.1	0.25	0.8	31.4	25.1	0.26	1.6	0.05	1.6	28.3	756.8	0.4	302.7
4	79.7	0.8	63.7	1	0.95	10.2	9.7	0.26	0.1	0.05	0.5	10.3	53.4	0.88	47.0
5	4.6	0.8	3.7	2	1	1.2	1.2	0.26	0.0	0.05	0.1	1.2	2.5	1	2.5
Total	1,654.5		852.5				36.0		1.8		2.1	39.9	812.6		**352.2**

1. Source: PFMC and NMFS (2007). Final environmental assessment for Pacific Coast salmon plan amendment 15: An initiative to provide de minimis ocean fishing opportunity for Klamath River fall Chinook. Pacific Fishery Management Council, Portland, Oregon.
2. Age specific ocean populations in May were estimated by multiplying the 2011 ocean population by the annual age-specific survival .
3. Personal Communication: Michael O'Farrell. NOAA-Fisheries Santa Cruz.

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Attachment B. Relationship between Klamath Basin Spring Chinook salmon inriver run based on Klamath Basin fall Chinook salmon inriver run for 2012.

A cursory analysis of the relationship between the adult Klamath Basin spring and fall Chinook salmon inriver runsize was conducted to provide additional information concerning the potential inriver run in 2012. Total inriver run data from the spring Chinook salmon "megatable" and the fall Chinook salmon "megatable" were used for this analysis. Although data are not complete for all harvest and escapement components of the run for the spring Chinook salmon data, these data are probably sufficient to provide a general indicator of the potential magnitude of the adult spring Chinook salmon inriver run. Data from 1981-2005 were used in this analysis, except for 1983 and 1995 when the Junction City weir was not operated. The data from these two years were excluded because the natural escapement above Junction City is a major portion of the run in most years.

The relationship between the adult spring Chinook and adult fall Chinook run is strong (r^2 = 0.71) but the relationship indicates there is greater variability at larger run sizes (Figure B1). An additional complicating factor in using this relationship to predict the 2012 adult spring Chinook salmon inriver run is that the 2012 fall Chinook inriver run prediction (352,200) is beyond the range of the dataset used to develop the regression equation. With these caveats in mind, the projected inriver size of adult spring Chinook salmon in 2012 is 84,500 fish.

The primary utility of this information is that, in addition to a larger fall Chinook salmon run, it should be expected that there will also be a large spring Chinook salmon run entering the Klamath Basin in 2012. This information will be updated when additional information becomes available.

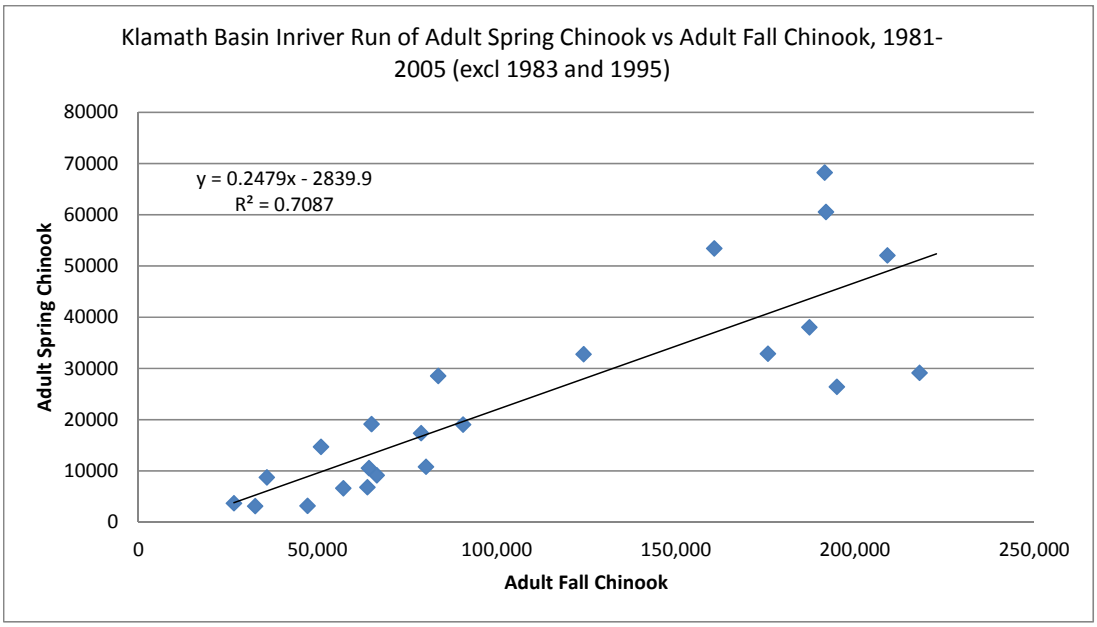

Figure B1. Relationship between the inriver run of adult spring Chinook salmon and adult fall Chinook salmon in the Klamath Basin.